Surveillance of **persistent organic pollutants** in foodstuffs of animal origin in 2014

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Abstract
In France, foodstuffs are regularly monitored in order to track contamination levels in French and imported products. This monitoring makes it possible to study trends and ensures that the maximum limits defined in the regulations are not exceeded. This article deals with the surveillance system managed by the Directorate General for Food (DGAL) in 2014 concerning persistent organic pollutants (POPs) (dioxins and PCBs, brominated flame retardants (BFRs) and polycyclic aromatic hydrocarbons (PAHs)) in foodstuffs of animal origin. A comparison with data from 2013 is also proposed.

In 2014, various programmes were implemented to monitor levels of POPs in animal foodstuffs (mainly set by Commission Regulation (EC) No 1881/2006), for a total of 4,932 samples taken, the vast majority of which involved DL-PCBs (1,954 samples) and NDL-PCBs (2,666 samples). This number of samples was higher than in 2013 (2,697 samples), but for these two years, conclusions were similar: observed contamination levels were low and the maximum limits were seldom exceeded (at a rate of less than 1%). Exceeded limits involved only dioxins and PCBs (DL and NDL) in fish meat. The alert thresholds (defined at national level) were also exceeded for the same compounds in game meat.

However, the conclusion should be confirmed in light of future sampling, due to small sample numbers and/or changes in the sampled matrices (foodstuffs of different natures, with different places of origin, etc. from one year to another).

Keywords
Persistent organic pollutants, Surveillance programmes, Monitoring programmes, Polychlorinated biphenyls, Dioxins, Polycyclic aromatic hydrocarbons, Brominated flame retardants

Résumé
Surveillance des polluants organiques persistants dans les denrées alimentaires d'origine animale en 2014
En France, les denrées alimentaires sont régulièrement contrôlées dans le but de suivre les niveaux de contamination dans les productions nationales et importées. Cette surveillance permet de suivre des tendances et de s'assurer du respect des teneurs maximales imposées par la réglementation. Cet article s'intéresse au dispositif de surveillance, piloté par la direction générale de l'Alimentation en 2014, relatif aux polluants organiques persistants (POP): dioxines et polychlorobiphényles (PCB), retardateurs de flammes bromés (RFB) et hydrocarbures aromatiques poly- cycliques (HAP) dans les denrées animales. Une mise en perspective par rapport aux résultats obtenus en 2013 est également proposée.
En 2014, plusieurs plans ont été mis en œuvre pour le suivi des teneurs en POP dans les denrées animales (principalement fixées par le règlement CE n°1881/2006), soit 4932 prélèvements dont une grande majorité concernant les PCB dioxin-like (DL) et dioxines (1 954 prélèvements), ainsi que les PCB non-dioxine like (NDL) (2 666 prélèvements). Ce nombre de prélèvements est supérieur à celui de 2013 (2 697 prélèvements) mais pour ces deux années le constat est identique: les niveaux observés de contamination restent faibles et les non-conformités sont peu fréquentes (moins de 1 %). Ces non-conformités concernent exclusivement des dioxines et PCB (DL ou NDL) dans la chair de poissons. On peut également observer des niveaux de contamination supérieurs aux seuils d'alerte fixés au niveau national pour ces mêmes composés dans la viande de gibier. Toutefois, certaines des conclusions devront être précisées à la faveur des prélèvements qui seront effectués à l'avenir, du fait des faibles nombres de prélèvements et/ou des changements dans les matrices prélevées (denrées de natures, de lieux d'origine, etc., différents d'une année à l'autre).

Mots-clés
Polluants organiques persistants, plans de surveillance, plans de contrôle, polychlorobiphényles, dioxines, hydrocarbures aromatiques polycycliques, retardateurs de flamme bromés

Every year, government administrations, including the Directorate General for Food (DGAL), the Directorate General for Competition, Consumer Affairs and Fraud Control (DGCCRF), and the Directorate General for Health (DGS), implement surveillance and control programmes (PSPC) in order to monitor the levels of chemical contaminants in food.

These PSPC involve a wide range of different substances such as inorganic and organic contaminants, veterinary medicinal products, pesticide residues and mycotoxins, and concern all the food products available on the market in France[1].

This review focuses more specifically on the PSPC implemented by the DGAL for the year 2014 that aim to monitor contamination levels of persistent organic pollutants (POPs) in food matrixes of animal origin. These compounds, which can be found in the environment and result mainly from human activity, whether industrial or domestic, are persistent, bioaccumulative and mobile. The scientific community has defined toxicity reference values for the compounds that have known toxic effects in humans.

1. See the article by Marion Bordier, "The surveillance system for food-chain contaminants managed by the DGAL: report on the 2014 surveillance and control plan campaign", in this edition

Persistent organic pollutants under monitoring

The POPs examined in this review are the following:

- brominated flame retardants (BFRs),
- dioxins and furans (PCDDs/PCDFs),
- polychlorinated biphenyls (PCBs), including dioxin-like PCBs (DL-PCBs), which have a toxic effect related to the same mechanism as PCDDs and PCDFs, and non-dioxin-like PCBs (or NDL-PCBs), which have a toxic effect that is different from dioxins,
- polycyclic aromatic hydrocarbons (PAHs).

Brominated flame retardants

BFRs are chemical substances included in a wide range of products and materials to reduce their flammability, from plastics and textiles to electronic equipment. The most commonly used are polybrominated diphenyl ethers (PBDEs), hexabromocyclododecanes (HBCDs), tetrabromobisphenol-A (TBBPA), and polybrominated biphenyls (PBBs). Since some of these BFRs have been identified as having toxic properties, use of several of these compounds has been prohibited for a number of years. This is the case specifically for PBBs and almost all PBDEs, with the exception of decabromodiphenyl ether (BDE-209), which is still authorised for use. Due to their persistence in the environment, these BFRs are still to be found in the environment, even if they are no longer used. This is why the programmes implemented in 2014 covered detection of eight PBDEs (BDE-28, BDE-47, BDE-99, BDE-100, BDE-153, BDE-154, BDE-183 and BDE-209) as well as three PBBs (BB-52, BB-101 and BB-153) in every sample, in addition to three forms of HBCD (alpha, beta and gamma), along with TBBPA.

Box. Surveillance of persistent organic pollutants in foods of animal origin carried out by the DGAL in 2014

Objectives

Monitoring of contamination levels for dioxins, dioxin-like polychlorinated biphenyls (DL-PCBs) and non-dioxin-like polychlorinated biphenyls (NDL-PCBs), and brominated flame retardants (BFRs) in foods of animal origin.

Programming framework

Directive 96/23/EC of 29 April 1996 on measures to monitor certain substances and residues thereof in live animals and animal products.

Decision 97/747/EC fixing the levels and frequencies of sampling provided for by Council Directive 96/23/EC for the monitoring of certain substances and residues thereof in certain animal products.

Decision 98/179/EC laying down detailed rules on official sampling for the monitoring of certain substances and residues thereof in live animals and animal products.

Commission Regulation (EC) No 1881/2006 of 19 December 2006 setting maximum levels for certain contaminants in foodstuffs.

Commission Regulation (EU) No 589/2014 of 2 June 2014 laying down methods of sampling and analysis for the control of levels of dioxins, dioxin-like PCBs and non-dioxin-like PCBs in certain foodstuffs.

Commission Regulation (EC) No 333/2007 of 28 March 2007 laying down the methods of sampling and analysis for the official control of the levels of lead, cadmium, mercury, inorganic tin, 3-MCPD and benzo(a)pyrene in foodstuffs.

The methods of sampling for monitoring BFRs are not defined in regulations but were established at the national level with the National Reference Laboratory responsible for these substances.

Protocol

POP contamination levels in foods of animal origin were assessed on the basis of various programmes:

- chemical residue monitoring programmes (including dioxins and PCBs) in animals for slaughter, poultry, rabbits, game,
- farmed fish, as well as milk and eggs,
- a surveillance programmes for certain BFRs in foodstuffs from terrestrial animals,
- a surveillance programmes for dioxins, PCBs, PAHs, and BFRs in
- bivalve molluscs,
- a surveillance programmes for chemical contaminants, including dioxins, PCBs, PAHs, and BFRs, in fishery products.

Production areas of interest: animals for slaughter (cattle, sheep, goats, and horses), poultry, rabbits, game, farmed fish, eggs, milk, and fishery products (fish, shellfish, cephalopods, and bivalve molluscs).

Food chain stage: primary production or first processing. All distribution channels for fishery products (hyper- and supermarkets, fishmongers, itinerant markets, etc.).

Analytical methods: official methods by gas chromatography coupled with high-resolution mass spectrometry or liquid chromatography coupled with tandem mass spectrometry.

Non-compliant sample: a sample is considered non-compliant when the level of a contaminant quantified in the sample exceeds the regulatory threshold given the expanded measurement uncertainty (k = 2) associated with the analytical result.

Dioxins and furans

The dioxin (polychlorinated dibenzo-p-dioxins (PCDDs)) and furan (polychlorinated dibenzofurans (PCDF groups)) include 75 and 135 different molecules, respectively. Among these multiple congeners, only those that are considered the most toxic are regulated, i.e. 7 PCDDs and 10 PCDFs.

Polychlorinated biphenyls

In addition to the dioxins, twelve congeners of the polychlorinated biphenyl (PCB) group are characterised by toxic properties similar to those of dioxins (DL-PCBs) and are also tested for during analyses.

Polycyclic aromatic hydrocarbons

Polycyclic aromatic hydrocarbons (PAHs) are a group of more than one hundred organic compounds with at least two aromatic rings. European regulations were initially based solely on benzo(a)pyrene levels, but an update in force from 2012 (Commission Regulation (EC) No 1881/2006) also established maximum levels for the sum of four PAHs: benzo(a)pyrene, benz(a)anthracene, benzo(b)fluoranthene, and chrysene.

Surveillance and control programmes implemented in 2014

The transfer of the various compounds in these POP groups from the environment (soil, sediment, suspended matter) to living organisms leads to their accumulation in animal fats. This lipophilic property underlies their accumulation in foods of animal origin. The PSPC implemented in 2014 by the DGAL involved the following foods:

- for terrestrial animals: meats, offal, fats, milk, and eggs,
- for seafood and freshwater products: fish meat, shellfish, cephalopods, and bivalve molluscs.

Samples are taken from farmed animals (animals for slaughter, farmed fish stocks, etc.) and from wild animals (game, fishery products, etc.).

The data collected for 2014 are also compared with equivalent data from the previous year to highlight any differences in contamination levels between these two years.

Materials and methods

Sampling and analyses

Samples are taken randomly for the surveillance programmes, i.e. there are no defined targeting criteria, while samples for monitoring programmes target foods from production sites in areas that are likely to be contaminated (based on the IREP[2] and BASOL[3] databases, among others). However, it is possible that targeting cannot be defined at the time of sampling. The observed contamination levels are therefore based on both randomly obtained samples and targeted samples, including on occasion within a single plan.

Implementation of the programme requires input from various different stakeholders. The DGAL determines a number of samples to be collected by region, generally on the basis of production levels. Each region then divides this number up among its various *départements*, which carry out sampling *via* decentralised services. The distribution among *départements* can follow various criteria on the basis of production volumes or number of production sites for instance, or be organised numerically by simply dividing the number of samples among the *départements*.

2. IREP: French register of pollutant emissions.
3. BASOL: database on polluted sites or contaminated land.

The analyses are carried out by laboratories accredited[4] by the Ministry of Agriculture, Food and Forestry to perform analyses, and by the Laboratory for the Study of Residues and Contaminants in Food (Laberca), National Reference Laboratory (NRL) for certain specific plans.

Censored data management

The results presented in this review are based on the upper bound hypothesis defined by the World Health Organization (WHO, 1995). This hypothesis results in processing of censored data[5] as follows: when the amount of substance is lower than the limit of detection (LOD), the amount is considered equal to the LOD. Likewise, when the amount of substance is lower than the limit of quantification (LOQ), the amount is considered equal to the LOQ. Quantified values are however retained as is.

Calculation of the sums in toxic equivalents (TEQ) for dioxins, furans, and PCBs

The overall concentration of dioxins and DL-PCBs in a sample is characterised by the sum of the mixture of the various congeners. Since dioxins and DL-PCBs each have a specific degree of toxicity, toxic equivalency factors (TEFs) have been defined in relation to the most toxic congener: 2,3,7,8-TCDD, also called the Seveso dioxin (Martin van den Berg *et al.*, 2006). This weighting coefficient indicates the degree of toxicity in relation to this reference compound, which was attributed the value 1. The product of "TEF x congener concentration" is used to calculate a toxic equivalent (TEQ) for each compound. The toxic equivalents of all the constituents of the sample mixture are then added together and define, in TEQ, the relative toxicity of the mixture of this sample.

Regulatory compliance

For control purposes, the results of the analyses carried out in the programmes of interest are compared with the maximum limits (MLs) established in the regulations or with nationally determined thresholds that apply to certain analyte/matrix pairs for which MLs have not been defined. In the second case, we can use the term alert threshold because these thresholds have no regulatory value.

The regulatory limits for dioxins, PCBs, and PAHs in food of animal origin are defined in Commission Regulation (EC) No 1881/2006. From a regulatory perspective, PCB and dioxin levels have not been defined for game. In this area, the DGAL has defined national alert thresholds using, as a reference, MLs for slaughter animals or poultry that are the closest to the game species in question. In this way, an alert threshold equal to the ML for swine was for example used for wild boars, and an alert threshold equal to the ML for poultry was retained for game birds.

There is no regulatory limit for BFRs. There is, nonetheless, a European surveillance recommendation (Commission Recommendation 2014/118/EU of 3 March 2014 on the monitoring of traces of brominated flame retardants in food). This recommendation calls for the Member States to monitor the presence of BFRs in different foodstuffs in order to reflect consumption habits and thus better characterise consumer exposure.

Concerning PAHs, it is important to be aware that new levels for benzo(a)pyrene and the sum of the four PAHs established in Regulation (EC) No 1881/2006 for smoked fish apply as of 1 September 2014.

4. List available at: http://agriculture.gouv.fr/laboratoires-agrees-et-reconnus-methodes-officielles-en-alimentation.
5. Tests with results below the analytical limit.

Results and Discussion

The surveillance programme implemented for 2014 concerned 4932 samples, including 1954 that were intended for the detection of DL-PCBs and dioxins, 2666 for NDL-PCBs, 121 for PAHs, and 191 for the quantification of BFRs.

Every year, the results of these analyses are communicated to ANSES by the control authorities as part of a data exchange agreement signed by the administrations and the Agency.

Brominated flame retardants

Concerning BFRs, it is not appropriate to define non-compliance levels given that there is no regulatory threshold applicable to these compounds.

The completion rate, i.e. the ratio of the number of samples planned to the number of samples effectively collected, was 97.4% for the 2014 BFR programme (5 planned samples were not collected). This rate is very similar to that achieved in 2013 (100%).

Table 1 presents the results for BFRs according to the various matrix groups. The contamination means are expressed in ng/g of fat, except for fishery products for which the results are expressed in ng/g of fresh product.

It is important to note that these results are not comparable between products produced on land and seafood because of a different denominator (g of fat *vs* g of wet product).

Table 1. Number of samples and contamination means (as per the upper bound hypothesis), in ng/g of fat or wet weight for fishery products, for the 2013 and 2014 PSPC carried out by the DGAL regarding brominated flame retardants (PBDE, PBB, HBCD, and TBBPA)

Matrix	Number of samples		Mean of sums of 8 PBDEs (ng/g)		Mean of sums of 3 PBBs (ng/g)		Mean of sums of 3 HBCDs (ng/g)		Mean for TBBPA (ng/g)	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Beef meat	10	10	0.61	5.63	0.02	0.04	0.36	0.42	0.04	0.02
Pork meat	10	9	0.28	0.93	0.01	0.01	0.13	1.56	0.03	0.03
Mutton/lamb meat	9	9	2.05	1.04	0.01	0.01	0.12	0.36	0.04	0.02
Sheep liver	10	9	0.74	1.03	0.03	0.04	0.12	0.27	0.07	0.03
Rabbit meat	4	6	1.06	5.75	0.03	0.02	0.10	0.12	0.04	0.02
Poultry meat	10	10	1.73	1.05	0.02	0.01	1.57	0.70	0.21	0.07
Eggs	20	19	0.80	0.35	0.01	0.01	0.38	0.10	0.01	0.01
Milk	25	25	0.18	0.50	0.01	0.01	0.06	0.08	0.03	0.01
Shellfish	6	5	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.00
Molluscs	52	47	0.08	0.07	0.00	0.00	0.09	0.07	0.00	0.00
Cephalopods	1	2	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00
Fish	37	40	0.26	0.17	0.01	0.00	0.08	0.10	0.03	0.00
Game meat	10	0	1.04	-	0.02	-	0.17	-	0.09	-
Total	**204**	**191**								

For the products from land animals, the maximum values observed for beef and rabbit meat led to a significant increase in the mean for the eight PBDEs *versus* 2013. However, the low number of samples in the land animal sectors (less than or equal to 10) implies low accuracy of these results. This low number of samples, associated with a high maximum value, is also the cause of the increased mean of the sums of the three HBCDs in pork between 2013 and 2014.

Conversely, between 2013 and 2014, a decrease was observed in mean contamination regarding the sum of the three HBCDs in poultry meat. Unfortunately, since this decrease was again based on a low number of food samples (only 10 analyses carried out each year), it is difficult to draw conclusions.

Table 2. Number of samples, contamination means (as per the upper bound hypothesis), in pg TEQ/g of fat or wet weight for fishery products, and number of non-compliant samples for the 2013 and 2014 PSPC carried out by the DGAL regarding dioxins and DL-PCBs

Matrix	Number of samples		Mean of sums of dioxins and DL-PCBs (pg TEQ/g)		Number of non-compliant samples	
	2013	2014	2013	2014	2013	2014
Poultry meat	53	478	0.43	0.21	0	0
Rabbit meat	7	10	0.47	0.35	0	0
Eggs	36	20	0.50	0.57	0	0
Milk	43	54	0.91	1.00	0	0
Beef fat	61	195	0.91	0.78	0	0
Pork fat	50	575	0.15	0.12	0	1
Sheep/goat fat	24	99	0.71	0.60	0	0
Sheep/goat liver	0	99	-	0.28	-	0
Game meat	12	45	2.38	1.35	1*	8*
Farmed fish	8	10	0.33	0.29	0	0
Wild fish	205	184	1.04	0.77	4	3
Shellfish	29	31	0.27	0.11	0	0
Cephalopods	7	4	0.04	0.21	0	0
Molluscs	150	150	0.71	0.59	0	0
Total	**685**	**1,954**				

* above national alert threshold (non-regulatory value).

Table 3. Number of samples, contamination means (as per the upper bound hypothesis), in ng TEQ/g of fat or wet weight for fishery products, and number of non-compliant samples for the 2013 and 2014 PSPC carried out by the DGAL regarding NDL-PCBs

Matrix	Number of samples		Mean of sums of NDL-PCBs (ng TEQ/g)		Number of non-compliant samples	
	2013	2014	2013	2014	2013	2014
Poultry meat	227	477	3.84	2.69	0	0
Rabbit meat	13	10	4.76	4.68	-	-
Eggs	97	90	3.02	3.56	0	0
Milk	80	81	3.91	4.25	0	0
Beef fat	364	594	4.09	3.17	0	0
Pork fat	329	576	2.20	2.20	0	0
Sheep/goat fat	95	298	4.41	2.55	0	0
Sheep/goat liver (fat weight)	0	99	-	9.31	-	0
Sheep/goat liver (wet weight)			-	0.51	-	0
Game meat	32	42	20.83	12.59	2*	1*
Farmed fish	32	30	3.35	4.53	0	0
Wild fish	207	184	9.96	5.87	2	2
Shellfish	29	31	0.91	0.20	0	0
Cephalopods	7	4	0.44	1.11	0	0
Molluscs	150	150	3.22	2.58	0	0
Total	**1,662**	**2,666**				

* above national alert threshold (non-regulatory value).

Dioxins (PCDDs/PCDFs) and PCBs

Completion rates were very similar for 2013 and 2014, with respectively 98.9% and 96.8% of planned samples effectively collected.

Table 2 presents the results for the sum TEQ for dioxins and DL-PCBs according to the various matrix groups. The observed levels are expressed in pg TEQ/g of fat for all the matrices, except for fishery products with results expressed per wet weight.

Given the specific regulatory context requiring a monitoring rate representative of the national production level (Council Directive 96/23/EC), the number of samples was essentially stable from one year to the next for most of the matrices. However, the number of samples increased in 2014 for fats (beef, pork, and sheep/goat meat), and for poultry and game muscle. The sheep liver matrix was also added. These changes led to a total of 1954 samples in 2014, *versus* only 685 in 2013.

The contamination levels observed in 2014 remain low and were overall about the same as those recorded in 2013. Non-compliance rates were below 1%, with 0.60% for 2013 and 0.22% for 2014, respectively.

For both years, game meat was the matrix with the highest dioxin and DL-PCB levels. The fall in the mean level between these two years should, however, be interpreted with caution given that the number of samples was multiplied by three and that the species sampled within the game group may have changed. Moreover, the alert thresholds were exceeded on more occasions in 2014 compared to 2013. In 2013 and 2014, these alerts concerned respectively one ostrich sample, and eight wild boar samples.

For wild fish, the three non-compliant samples in 2014 were two mackerels (Atlantic Ocean for one and non-specified area for the other), and one tuna (Mediterranean). In 2013, the alert thresholds were exceeded four times. They involved two salmon samples (Baltic Sea), one tuna (Mediterranean), and one eel (from the Netherlands).

Concerning NDL-PCBs, of all the congeners, six represented about half of the total amount of PCBs contained in food (PCB-28, PCB-52, PCB-101, PCB-138, PCB-153 and PCB-180). Since 2011, the sum of these six PCBs has been regulated because it is considered a good indicator of NDL-PCB contamination. As these congeners do not have the same toxicity characteristics as dioxins, the calculated sum is not weighted using a toxicity equivalence coefficient.

Between 2013 and 2014, the completion rate was stable at 97.2% despite a much higher number of samples in 2014 (2666 samples *versus* 1662 in 2013).

Table 3 presents the results for NDL-PCBs according to the various matrix groups. The observed levels are expressed in ng TEQ/g of fat for all the matrices, except for fishery products where results are expressed per fresh weight. Two separate lines are indicated for sheep and goat livers: one with the result expressed in ng TEQ/g of fat and the other with the result expressed in ng TEQ/g of fresh weight. This is explained by the change in the definition of maximum levels that occurred in 2014 *via* Regulation (EC) No 1881/2006 (change from maximum level of 40 ng TEQ/g of fat to 3.0 ng TEQ/g of wet weight).

The contamination levels observed in 2014 remain low and were comparable to the levels reported in 2013. The non-compliant rate calculated for 2014 was very close to that for 2013 (0.08% and 0.12%, respectively).

Table 4. Number of samples, contamination means (as per the upper bound hypothesis), in µg/g of wet weight, and number of non-compliant samples for the 2013 and 2014 PSPC carried out by the DGAL regarding PAHs

Matrix	Number of samples		Mean of benzo(a) pyrene (µg/g)		Mean of sums of four PAHs (µg/g)		Number of non-compliant samples for benzo(a) pyrene		Number of non-compliant samples for the sum of four PAHs	
	2013	2014	2013	2014	2013	2014	2013	2014	2013	2014
Smoked fish	75	53	0.21	0.22	0.70	0.55	0	0	0	0
Bivalve molluscs	71	68	0.30	0.33	2.95	2.41	0	0	0	0
Total	**146**	**121**								

In 2014, a sample of muscle from a wild boar exceeded the alert threshold above which an investigation is initiated to identify the source of contamination in the environment. In 2013, the two cases in which the alert threshold was exceeded were related to farmed ostrich and wild boar muscle samples. Like in the case of dioxins and DL-PCBs, the decrease in the NDL-PCB level observed in game meat between 2013 and 2014 could be related to sampling (different sampled species from one year to the next) and not to an actual decrease in contamination. This trend would therefore need to be confirmed.

The two non-compliant fish samples in 2014 were the same samples of mackerel (Atlantic Ocean and non-specified area) as the non-compliant samples for dioxins and DL-PCBs. For 2013, one tuna (Mediterranean) and one eel (from the Netherlands) were non-compliant. These were the same samples that were already non-compliant for dioxin and DL-PCB levels.

Polycyclic aromatic hydrocarbons

For 2013 and 2014, the completion rates were 100% and 99%, with only one sample not being collected in 2014. We can nonetheless observe that the number of samples decreased between these two years, particularly concerning smoked fish (about 20 fewer samples).

Table 4 presents the results for PAHs according to the various matrix groups. The levels observed are expressed in µg/kg of wet weight for all the matrixes.

The contamination levels were essentially the same between 2013 and 2014. For both these years, no samples exceeded the compliance thresholds for PAHs. During 2014, the regulatory thresholds for smoked fish were lowered for benzo(a)pyrene (2 µg/kg instead of 5 µg/kg) and for the sum of the four PAHs (12 µg/kg instead of 30 µg/kg), without this leading to any non-compliance.

Conclusions and outlook

For all the POPs monitored in the PSPC, the observed contamination levels remain low overall and are below the thresholds established either by European regulations (maximum limits), or nationally by the DGAL (alert

thresholds). In the case of maximum limits, the observed cases of non-compliance exclusively involved exceeded levels for dioxin and PCBs (DL or NDL) in fish meat. These same compounds were also implicated in the exceeded alert thresholds established nationally for game meat. Nonetheless, joint efforts on sources of contamination, particularly incinerators, and food controls have enabled a significant reduction in consumer exposure to dioxins and PCBs (ANSES, 2011). The new regulations concerning NDL-PCBs have helped reinforce this programme.

In 2015, the sampling plan regarding dioxins, PCBs, and PAHs was renewed practically in line with 2014, except for fishery products. This is due to an analysis of all the contamination data available for fishery products over the last five PSPC campaigns that was used to develop a new sampling plan. Although it has the same number of samples collected nationally as in previous years, this new programme focuses on the most relevant species, i.e. those with the highest levels of contamination (e.g. predator fish) and/or those with the highest consumption levels. A portion of the sampling remains targeted at low contamination and low consumption species to maintain minimal surveillance of these species.

Concerning BFR, there are currently no European regulations setting maximum limits for these compounds in foodstuffs. In 2015, detection of BFRs continued, to comply with Recommendation 2014/118/EU regarding their monitoring. It would be interesting to review monitoring of BFRs between 2012 and 2015 to improve the precision of results for each matrix.

Lastly, some of the conclusions will need to be confirmed through future sampling given the occasionally limited number of samples for a food group/contaminant group pair. For 2014, only a dozen analyses of BFRs were performed for each type of butchery meat (beef, mutton/lamb, and pork). As a result, it is essential to maintain high sampling levels because in addition to the main objective of monitoring contamination levels, the current programme also generates contamination data that are used by risk assessment experts (ANSES, EFSA). These data help to regularly update this assessment. This assessment is more accurate when the analytical limits retained by laboratories are low, and the programmes implemented by the DGAL meet the objectives defined by all the stakeholders.

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